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(57) Abstract

An image display apparatus (600) and a control system therefor, for displaying a sequence of images divided into a series of groups of images, such that the images of different groups may be displayed at different times during the day. The display of the images may also be synchronised with sound reproduction means (608, 620, 614), and the control system for the visual display (604) may include reflective sensors or barcode sensors (606) to aid in positioning the images for display. A motion sensor (622) may be provided coupled to the central micro-controller (602) to effect a shutdown of the visual display (604) if there is no motion in the vicinity of the display apparatus (600). The image display medium for the visual display (604) includes spacing strips along its edges to avoid surface damage thereto.

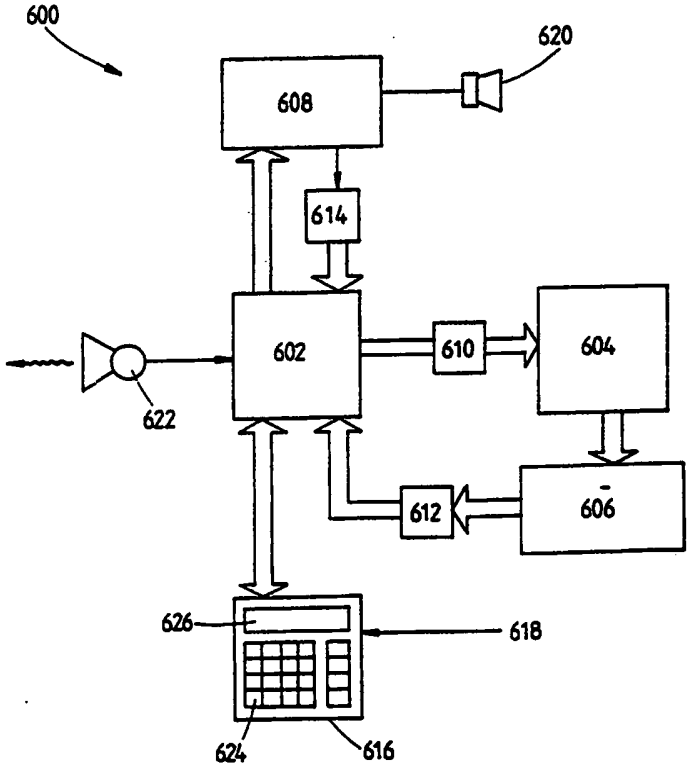

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IMAGE DISPLAY AND CONTROL APPARATUS

This invention relates generally to the display of images, and more particularly to apparatus for displaying images, the control of such apparatus, and means and methods for the reduction of damage to display material which may be used in the display apparatus.

In accordance with a first aspect of the present invention there is provided a control apparatus for use with sound reproduction means and image display means for displaying a sequence of images, said sound reproduction means, in use, reproducing a sequence of stored sounds, said control apparatus comprising digital memory means for storing audio signals, and processing means for generating display control signals for controlling said image display means to display the next image in the sequence of images in response to an audio control signal accessed from said digital memory means.

In accordance with a second aspect of the present invention there is also provided a control apparatus for use with image display means which, in use, sequentially displays images of a selected group from a plurality of groups of images, said control apparatus comprising processing means responsive to first control signals to cause said image display means to display the next image of said selected group of images, and responsive to second control signals to cause a succeeding group of images to become said selected group.

The present invention also provides an image display apparatus comprising image display means, and control means for controlling said image display means, said image display means, in use, sequentially displaying images of a selected group from a plurality of groups of images, said control means comprising processing means responsive to a first control signal to cause said image display means to display the

next image of said selected group of images, and responsive to a second control signal

This invention relates generally to the display of images, and more particularly to apparatus for displaying images, the control of such apparatus, and means and methods for the reduction of damage to display material which may be used in the display apparatus.

In accordance with a first aspect of the present invention there is provided a control apparatus for use with sound reproduction means and image display means for displaying a sequence of images, said sound reproduction means, in use, reproducing a sequence of stored sounds, said control apparatus comprising digital memory means for storing audio signals, and processing means for generating display control signals for controlling said image display means to display the next image in the sequence of images in response to an audio control signal accessed from said digital memory means.

In accordance with a second aspect of the present invention there is also provided a control apparatus for use with image display means which, in use, sequentially displays images of a selected group from a plurality of groups of images, said control apparatus comprising processing means responsive to first control signals to cause said image display means to display the next image of said selected group of images, and responsive to second control signals to cause a succeeding group of images to become said selected group.

The present invention also provides an image display apparatus comprising image display means, and control means for controlling said image display means, said image display means, in use, sequentially displaying images of a selected group from a plurality of groups of images, said control means comprising processing means responsive to a first control signal to cause said image display means to display the next image of said selected group of images, and responsive to a second control signal

to cause a succeeding group of images to become said selected group.

Preferably said sequence or group of images comprises a number of images joined to form a length of images coiled, in use, in overlapping fashion upon at least one of first and second spools. Preferably said groups of images are joined sequentially to form a length of images such that the last image of one group of images is joined to the first image of the next group.

Preferably, when said image display means displays the next image of said sequence or groups of images, said second spool is rotated so as to coil a portion of said length of images upon said second spool.

The image display means may comprise:

motion means for effecting movement of the images into a display area in which one of said images is displayed, said motion means including at least one electric motor, and the

control means may control said at least one motor to effect said movement in response to the control signals and motion signals from said at least one motor. Said motion signals may comprise back emf signals or pulse counting signals, which indicate movement of said images.

In a preferred embodiment of the invention the images are contained on a length of display material which, in use, is coiled upon at least one of first and second cylindrical spools having generally parallel axes, such that one of the first and second spools may be rotationally driven to wind a portion of the display material upon the spool so as to a move said image into a display area of the apparatus located between the two spools. The images contained on the display material may be displayed sequentially, one by one, whilst the display material is being wound upon the second spool, and subsequently rewound upon the first spool for the images to again be displayed. The display material containing a particular sequence of images may thus be unwound and rewound upon the first and second spools continuously over the

whole or a portion of the day.

When a display material is coiled in overlapping fashion the inwardly facing surface of one layer of a coil on a particular spool would ordinarily make contact with the outwardly facing surface of the underlying layer. The continued coiling and uncoiling of the layers of the coil can cause relative movement therebetween, resulting in damage such as scratching of the surfaces of the display material. Over a period of time, this damage may accumulate so as to reduce the attractiveness and visual effect of the images on the display material.

Furthermore, the above mentioned display material may, for example, comprise a plurality of transparencies joined end-to-end to form a single length of display material. If the edges of adjacent transparencies of the display material are not aligned accurately when they are joined, further damage to the transparencies may occur as a result of lateral movement of the display material across the plane containing the first and second spools. Such lateral movement can cause the display material to contact stationary portions of the image display apparatus, resulting in damage to the edges of the transparencies. Moreover, uneven tension of the display material due to the inaccurate alignment, may also weaken the joints between the transparencies.

The means of joining adjacent transparencies may also effect the accumulate damage to the display material over a period of time. It has been found, for example, that if adjacent transparencies are joined in an abutting fashion by means of flexible adhesive tape, the increased flexibility at the abutting join can enable the central edge portions of the joined transparencies to contact a subsequent layer of display material, when coiled, even if the edges thereof are prevented from contacting one another.

In accordance with another aspect of the present invention there is therefore provided display material capable of being coiled, including spacing means disposed adjacent the edges thereof.

There is also provided a method for preserving display material which, in use, is coiled, comprising providing spacing means adjacent the edges of said display material.

The spacing means may comprise at least one flexible strip of a material which is attached to the display material along the edges thereof.

The display material may be formed from a single length of material or, alternatively, may be formed from a plurality of sections connected end to end.

Where the display material is comprised of a plurality of sections, separate lengths of the spacing means may be disposed along the edges of each section, or a single length of the spacing means made by provided along the edges of a plurality of the sections.

Where the display material is comprised of a plurality of sections, the adjacent sections are preferably joined such that the joined end edges thereof overlap each other.

In accordance with another aspect, the present invention provides a tool for aligning first and second portions of display material, comprising aligning means which, in use, aligns with a feature of each of said first and second portions, and holding means for holding said first and second portions in said alignment for joining therebetween.

Preferred embodiments of the present invention will hereinafter be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a block diagram of a preferred display apparatus according to the present invention:

Figure 2 shows scrolling apparatus of the image display means of a first

embodiment;

Figure 3 shows control means of the first embodiment;

Figure 4 is a flow chart of the operation of the control means of Figure 3;

Figure 5 is a modified operational flow chart of the control means of Figure 3;

Figure 6 shows a cut away plan view of the image display apparatus of the first embodiment;

Figure 7 shows a cross-sectional view of the image display apparatus through Section A-A of Figure 6;

Figure 8 is a truth table for the control means of the scrolling apparatus of the first embodiment;

Figure 9 shows scrolling apparatus of the image display means of a second embodiment;

Figure 10 shows a cross-sectional view of the image display apparatus in accordance with the second embodiment;

Figure 11 shows a side view of a tractor feed device for use in the second embodiment;

Figure 12 shows an end view of the tractor feed device of Figure 11;

Figure 13 shows an example of a length of the image display medium, in accordance with the second embodiment;

Figure 14 is a schematic diagram of the image display apparatus of the second embodiment;

Figure 15 is a schematic diagram of the sound reproduction means of the second embodiment;

Figure 16 shows an example of an internal control panel of the second embodiment;

Figure 17 shows an auxiliary internal control panel of the second embodiment;

Figure 18 shows a main operational flow chart of the control means of the second embodiment of the present invention;

Figure 19 shows a flow chart for detection of a jammed condition of the scrolling apparatus;

Figure 20 shows a flow chart of an image group selection routine.

Figure 21 shows a coiled length of display material;

Figure 22 shows a scrolling apparatus;

Figure 23 shows a display material formed from sectional lengths;

Figure 24 shows a cutaway section of the display material of Figure 23, whilst coiled on a spool;

Figure 25 is a plan view of a tool useful for aligning adjacent sections of display material prior to interconnection thereof;

Figure 26 is a cross-sectional view of the tool of Figure 25, through 6-6;

Figure 27 is a plan view showing a join between adjacent sectional lengths of display material;

Figure 28 is a plan view of a tool useful for aligning adjacent sections of display material prior to interconnection thereof in the fashion showin in Figure 27;

Figure 29 shows a block diagram of image display apparatus according to a third embodiment;

Figure 30 is a programming flowchart for use in the third embodiment; and

Figure 31 is a flowchart of operation of a vicinity movement detector of the third embodiment.

The preferred embodiments of the present invention relate to display apparatus useful in such applications as advertising. The apparatus is relatively inexpensive and simple in construction, in comparison with alternatives such as video displays. Figure 1 shows a block diagram of the display apparatus 2 comprising visual display means 8, control means 4 and sound reproduction means 6. Both the visual display means 8 and the sound reproduction means 6 are operatively connected to the control means 4 such that the control means is able to control the visual display means and the sound reproduction means in accordance with a predetermined procedure. In use, the sound reproduction means 6 provides control signals to the control means 4 which are decoded by the control means to control the visual display means 8.

The sound reproduction means 6 may be any common sound reproducing device such as audio tape or cassette play back apparatus or may be a digital voice

recorder/playback device. The first embodiment utilises magnetic audio cassette tape apparatus having a magnetic audio tape which may be formed in a continuous loop. A second embodiment utilises a digital audio recording and playback device, in use storing and retrieving sounds digitally in semiconductor memory.

The image display apparatus 2, as described hereinafter, may comprise a free standing structure or alternatively may be incorporated in a vending machine, such as a cigarette, food or drink vending machine. The free standing structure may include a visual display which is, for example, one and a half metres high and 500 cm wide for enhanced visual impact. For a display apparatus incorporated in a vending machine, the size of the display would be ordinarily chosen so as to be of similar dimensions to a static display which normally exists in such machines. Alternatively, the apparatus may be installed within a wall of a room such that the visual display faces the interior of the room in a space which might ordinarily be occupied by an advertising poster or the likes. The apparatus may, for example, find application in passenger areas of airport buildings, and could be utilised to identify particular airlines at airport gate areas where a plurality of airlines use a single gate during different times of the day.

Figure 2 shows scrolling apparatus 10 of the visual display means 8 of the first embodiment. The scrolling apparatus 10 comprises upper and lower cylindrical spools 16, 18 upon which are wound a flexible elongate image display medium 24. The spools 16, 18 are arranged in a coplanar parallel orientation, and spaced sufficiently to allow an image 23 to fit therebetween. The image display medium 24 is formed by piecing together end-to-end, in sequence, a number of images 23 to be displayed by the display apparatus. Each image 23 in the sequence may be a transparency though which light is shone to display the image, or may be in the form of a poster. The images are laminated with transparent plastic to provide protection and stability whilst maintaining flexibility, and sequentially joined by means of flexible adhesive tape. The edge of one end of the image display medium 24 is joined to the upper spool 16, and the other end joined to the lower spool 18. At any one time most of

the image display medium 24 is wound upon one or both of the upper and lower spools 16, 18 in such a way that, in use, a portion of the image display medium 24 approximately the size of one image 23 is held between the two spools at any particular time. The upper spool 16 is rotatably supported at one end by upper bearing shaft 20, which engages with an upper bearing carrier 19 (Figure 6), and at the other end is coupled to the rotatable shaft of upper drive motor 12. Similarly, the lower spool 18 is rotatably supported at one end by lower bearing shaft 22 and bearing carrier 21, and at the other end coupled to lower drive motor 14.

Figures 6 and 7 show the mechanical arrangement of the image display means 8 of the first embodiment. The upper and lower bearing shafts 20, 22 of the upper and lower spools rotatably engage with the upper and lower bearing carriers 19, 21 which are affixed to a chassis 138. The upper and lower drive motors 12, 14 are also affixed to the chassis 138 such that when the upper drive motor is energised the upper spool is rotated, and when the lower drive motor is energised the lower spool rotates. The chassis 138 also supports cylindrical guide bars 144 (not shown in Figure 6), two guide bars adjacent to each of the upper and lower spools, with each of the guide bars having its axis parallel to the spools 16, 18. The image display medium 24 is guided over a desired path from one of the upper and lower spools 16, 18 over two guide bars 144 to a flat perspex light diffuser 146 (shown in Figure 7) located between the two spools. The image display medium 24 passes over the surface of the diffuser 146 and over the guide bars to the spool at the other end of the chassis 138. The apparatus is contained within a box enclosure 136 and cover 148 having a transparent portion in a position corresponding to that of the diffuser 146. The size of the diffuser 146 and the transparent portion of the cover 148 correspond approximately to the size of the image 23 to be displayed by the apparatus. The chassis 138 containing the scrolling apparatus 10 is secured to a rear interior surface of the box enclosure 136 by means of securing bolts 140. The visual display means also includes fluorescent lights 142 mounted on the rear interior surface of the box enclosure 136 to shine light through the diffuser 146, the image 23 and the transparent portion of the cover 148 to thereby display the image 23 currently adjacent the diffuser 146.

Each of the upper and lower bearing shafts 20, 22 may also be provided with a crank socket 11 in one end thereof. As shown in Figure 7, the sockets 11 are provided at the axial center of each bearing shaft 20, 22 in the end thereof which is distal to that driven by motors 12, 14 respectively. The socket 11 may alternatively be provided in a gear shaft which is coaxial with and geared to the bearing shaft 20, 22 or spool 16, 18. The sockets 11 are shaped so as to allow a co-operating complimentary crank handle shaft (not shown) to be inserted therein, such that the crank handle may be rotated manually to effect rotation of the bearing shaft 20, 22. Such a feature is useful in the event of a power failure to the image display apparatus, or in the event of a failure of one of the motors 12, 14 or the controlling circuitry as it enables some degree of manual control over positioning of the images in the apparatus. To facilitate easier use of this feature an aperture may be provided in the bos enclosure 136 adjacent each socket 11, to enable a crank handle shaft to be inserted therein to engage the socket 11.

Each image 23 is also provided with a stop tab 13 (Figure 2) which cooperates with an optical sensor 15 (Figure 6, 7) to provide an indication of the correct positioning of the image 23. A stop tab 13 is positioned in one corner of each image 23 of the image display medium 24, and the optical sensor 15 is located within the box enclosure 136 such that its sensing surface is adjacent the surface of the image display medium 24 wound on the lower spool 18. The stop tabs are positioned so that, when an image 23 is correctly aligned on the surface of the diffuser 146, a stop tab 13 is immediately adjacent the sensing surface of the optical sensor 15.

Figure 3 is a block diagram of the control system of the first embodiment. The operation of the control system is coordinated by a control circuit 100 which receives inputs 76, 78, 80, 82, 84, 86 and 88 and provides outputs 90, 92, 94 and 96. The control circuit 100 may comprise a fixed logic array or a micro controller/microprocessor type device, however, in the first embodiment the control circuit 100 comprises an electronically programmable logic device (EPLD).

Control system 31 receives left and right audio inputs 30, 32 which are summed and input to an audio buffer amplifier 34. The output of amplifier 34 is fed to a dual tone multi-frequency (DTMF) decoder 36 which provides four DTMF decoder inputs 76 to the control circuit 100. Control system 31 also receives an input 40 from the optical sensor 15 which is fed to stop tab sensor 42 and then to buffer amplifier 44. The output from amplifier 44 provides the stop tab sensor input 80 to control circuit 100.

A primary function of control system 31 is to synchronise the sequential display of images on the visual display means 8 with pre-recorded portions of sound reproduced by the sound reproduction means 6. The synchronisation is effected by means of control signals which are also reproduced by the sound reproduction means 6. Hence, it is possible to display an image with the visual display means 8 whilst playing corresponding pre-recorded sounds such as music or speech relating to the image, and synchronise the display of the next image in the sequence with the corresponding portion of pre-recorded sound.

The control signals utilised in the first embodiment are in the form of DTMF signals, commonly used in telephone signalling systems. The DTMF signals, which are pre-recorded on one or both of the left and right audio channels of the sound reproduction means, are decoded by the DTMF decoder 36 which provides a four bit digital code 76 to the control circuit 100. Different DTMF codes from the sound reproduction means 6 may correspond to instructions such as advance to the next image, rewind to the beginning of the image sequence, return to the previous image in the sequence, etc.

Control circuit 100 provides three outputs 92, 94, 96 to control the visual display means 8. Motor drive output 96 is fed to motor drive amplifier 58 and from there to input terminals of upper and lower relays 66 and 68. Upper motor select output 94 is fed through upper motor drive amplifier 60 to control the switching of upper relay 66. When the upper motor select output 94 is logical 1 the upper relay

66 is switched such that the output from the motor drive amplifier 58 is connected to upper motor input 70. When the upper motor select output 94 is not energised upper relay 66 is switched such that upper motor input 70 is not energised but is electrically connected to motor sensor 48 via terminal 71. Lower motor select output 92 controls the lower relay 68 in similar fashion so that, when output 92 is at logic 1 motor drive amplifier output 58 is connected to lower motor input 72, and when the output 92 is at logic 0 the lower motor input 72 is connected to the motor sensor 48.

During normal operation of the scrolling apparatus 10 three functions are ordinarily utilised: scroll up, scroll down, and hold. The scroll up function is effected by energising upper drive motor 12 whilst leaving lower drive motor 14 disconnected. Figure 8 shows the logic states of outputs 92, 94 and 96, and the relative voltages at upper and lower motor inputs 70 and 72. As is apparent from Figure 8, when logic 1 is asserted at motor drive output 96 a relative high voltage appears at the output of the motor drive amplifier 58. When logical 0 is asserted at the motor drive output 96 the voltage which appears at the output of the motor drive amplifier 58 is a relative low voltage. Thus, to move the image display medium 24 upwards in the scrolling apparatus the scroll up function is selected by asserting logical 1 at outputs 94 and 96 and asserting logical 0 at output 92. This has the effect of connecting the lower drive motor 14 to the motor motion sensor 48 whilst applying the relative high voltage the upper drive motor 12. Similarly the image display medium may be scrolled in the downward direction using the scroll down function by applying logical 1 to output 92 and 96 and applying logical 0 to output 94. The hold function is utilised when an image 23 is positioned correctly for viewing on the scrolling apparatus, to apply a small tension to the image display medium and hold the image in the correct position. This is accomplished by applying a relative low voltage to both the upper and lower drive motor input 70, 72 simultaneously. Figure 8 shows the logic conditions at outputs 92, 94 and 96 necessary to accomplish this function.

Control circuit 100 is also provided with a motor motion sensor input 82. During motion of the image display medium 24 within the scrolling apparatus 10, only

one of the upper and lower drive motors is energised at any particular time. However, since the upper and lower drive motors are rotatably coupled to each other by means of the image display medium 24 wound upon the upper and lower spools 16, 18, when one of the drive motors is energised to wind the image display medium upon its spool the other drive motor also rotates by virtue of the image display medium unwinding. Thus, motion of the image display medium 24 may be sensed by examining the back emf produced by the rotation of the motor which is not energised. This back emf signal 46 may be easily detected by motor sensor 48 by means of relay terminals 71 and 73. The motor motion sensor signal is amplified by a buffer amplifier 50 and fed to the control circuit 100 as the motor motion sensor input 82.

The display apparatus of the first embodiment may also be controlled manually by switching an automatic/manual switch 54 to its manual position. With switch 54 in the manual position the scrolling apparatus 10 is no longer controlled in accordance with DTMF signals from the sound reproduction means. With the switch in the manual position the logic signal indicating that the next image in the sequence should be displayed is provided in accordance with a manual delay selector 38 and manual delay timer 52. The manual delay selector 38 may be in the form of a thumb wheel switch which provides a manual delay selector input 78 to the control circuit 100. When the value of manual timer input 84 from the manual delay timer 52 reaches the value of the manual delay selector input 78 the control circuit 100 initiates movement of the image display medium to display the next image 23 in the sequence of images.

Figure 4 shows a simplified flow chart 102 of the operation of control system 31 under normal conditions. The procedure of flow chart 102 requires that the pre-recorded sounds and control signals reproduced by the sound reproduction means 6 playable in repeatable fashion. The pre-recorded sounds are recorded in sequence corresponding to the sequence of images to be displayed, followed by pre-recorded sounds in reverse sequence. Only three different control signals are required to be reproduced by the sound reproduction means. One control signal is required to initiate movement of the scrolling apparatus to display the next image 23 in the sequence, and

another control signal is required to instruct the control system 31 to display the previous image in the sequence. The final control signal forces the scrolling apparatus to rewind. These control signals are pre-recorded together with the aforementioned sounds, at appropriate points on the tape.

Steps 105 to 107 of procedure 102 ensure that the image display medium 24 is rewound (ie. wound upon one spool only) such that the first image in the sequence of images is displayed by the visual display means. This is accomplished by energising the lower drive motor 14 whilst detecting the back emf of the upper drive motor 12. At steps 106 and 107 the motion of the spools 16, 18 and the image display medium 24 is sensed using the detected back emf of the upper drive motor 12 via terminal 71 motor senor 48 and buffer amplifier 50. When the image display medium 24 is completely rewound rotational movement of upper spool 16 and the shaft of upper drive motor 12 ceases, and the back emf sensed at the motor motion sensor input 82 is reduced to zero. A back emf of zero from the upper drive motor 12 while the lower drive motor 14 is still energised is an indication that the image display medium 24 is completely rewound, and this is the condition examined at step 107. At this time the forward scrolling direction is set to the upward direction (step 107a) such that the image display medium 24 is progressively wound upon the upper spool 16. Steps 108 and 109 scroll the image display medium 24 forward until a stop tab corresponding to the first image in the sequence of images is sensed by the optical sensor 15. This ensures that the image 23 is displayed correctly aligned on the diffuser 140. At steps 110 and 111 the control apparatus waits for a move pulse control signal from the sound reproduction means via the audio buffer amplifier 34 and the DTMF audio decoder 36. When the move pulse is received the scrolling apparatus scrolls the image display medium 24 in the required direction to display the desired image 23 in the sequence of images. Steps 113 and 114 ensure that the image display medium is not at its end, and if it is not then the desired image in the sequence is scrolled to alignment as indicated by the stop tab (step 109). When the end of the sequence of images as been reached (step 114) the control system 31 acts to reverse the scrolling direction such that the forward direction of scrolling becomes

the downward direction. At step 119 the control circuit 100 checks for a fault condition, and if a fault is detected an alarm condition output 90 is energised to sound a buzzer 74 via a buzzer drive amplifier 64 (Figure 3). An example of such a fault condition is if more than five reverses of scrolling direction are carried out within one minute. If no fault condition exists and no rewind tone is received at step 119a then the procedure returns to step 108 whereupon the images are again displayed, in reverse sequence order, in a manner similar to that described above. If a rewind tone is received at step 119a then the procedure returns to step 105. Using an appropriate pre-recorded audio tape and procedure 102 the display apparatus 2 may operate continuously, alternately displaying the images in forward sequence order and reverse sequence order, accompanied by the corresponding sounds from the sound reproduction means.

Figure 5 shows a modified operating procedure 120 which is appropriate to be used when control system 31 is placed in the manual mode by switch 54. At steps 122 to 124 the image display medium 24 is rewound on to the lower spool 18, as in procedure 102. During steps 125 to 131 the images 23 are displayed individually in sequence, the next image in the sequence being displayed when a move pulse is received (steps 127 and 128). In this case, the move pulse control signal may be received from either the audio tape via the DTMF audio decoder 36 or from the manual delay timer 52. When the end of the sequence of images is reached, as indicated by the back emf of the motor not being driven (steps 130 and 131), and no fault condition exists (step 133), the procedure returns to step 122 where the image display medium 24 is again rewound and the procedure repeated.

Figure 9 shows scrolling apparatus 10 of the visual display means 8 of a second embodiment of the present invention, where reference numerals in common with Figure 2 denote similar items. The scrolling apparatus 10 of the second embodiment differs from the scrolling apparatus of the first embodiment in several respects. To aid in guiding the image display medium 24 the scrolling apparatus 10 is provided with one or more tractor feed devices 164 along each edge of the image

display medium 24. The image display medium is also provided with a corresponding series of guide holes 166 along each of its edges. In use, as the image display medium 24 is scrolled from one of spools 16, 18 to the other, the edge of the image display medium 24 passes through the respective tractor feed device 164 wherein the guide holes 166 engage with guide projections 172 of the tractor feed device. Figures 11 and 12 show side and end views of a typical tractor feed device, as are commonly used in tractor paper feed computer printers. A continuous flexible belt 180 is contained on cylindrical rotatable spools (not shown) which are arranged in a co-planar parallel orientation, the belt being provided with guide projections 172. The flexible belt 180 is rotatable around the spools such that the guide projections 172 follow a path through a groove 176 formed in an upper lid portion 178 of the tractor feed device 164. In use, the guide projections 172 engage the guide holes 166 of the image display medium 24 at one end of the tractor feed device 164 so as to guide the edge of the image display medium 24 along the tractor feed device 164 to the other end of the device. An arrangement such as this, with one or more tractor feed devices along each edge of the image display medium 24 in the scrolling apparatus 10 allows good tensioning of the image 23 as it passes between spools 16 and 18.

Figure 10 shows a side cross-sectional view of the mechanical arrangement of the image display means 8 of the second embodiment, where reference numerals in common with Figure 7 denotes similar items. The apparatus operates essentially the same as that described in relation to Figures 6 and 7, except in this embodiment cylindrical guide bars 144 are not provided adjacent the upper and lower spools 16, 18. In this embodiment the image display medium 24 passes from one spool 16, 18 directly over perspex diffuser 146, provided in the space between spools 16 and 18, and onto the other spool. The perspex diffuser 146 is provided in close proximity to the spools 16, 18 to allow the image display medium 24 to be guided easily over the diffuser 146 without the aid of guide bars.

Figure 13 shows a length of the image display medium 24 containing a sequence of images 23, in accordance with the second embodiment of the present

invention. The second embodiment allows the images 23 of the image display medium 24 to be divided into image groups 169. The image groups 169 are delimited by a start tab 170 located in the lower left hand corner of an image 23 adjacent the first image 167 in a group 169, and an end tab 168 located in the upper right hand corner of the first image 167 in a group 169 adjacent the last image 171 in the previous group 169. The start tabs 170 co-operate with optical start sensor 160 (Figure 9) to indicate the first image 167 group of images 169. The end tabs 168 co-operate with an optical end sensor 162 (Figure 9) to indicate the last image 171 a group of images 169. When the first image 167 of a group of images 169 is displayed by the scrolling apparatus (for example, the image 170 is adjacent the diffuser 146 (Figure 10)) the start tab 170 is immediately adjacent the optical start sensor 160. When the last image 171 of a group of images 169 is being displayed the end tab 168 is immediately adjacent the optical end sensor 162.

Figure 14 shows control means 401 provided in accordance with the second embodiment of the present invention. The control means 401 comprises four major components: control logic 403, an internal control panel 182, a sound recording and reproduction means 406 and a function select timer section 425. These four major sections are interconnected to provide electrical control signals to the upper and lower drive motors 12, 14.

The controlling functions of the control means 401 are provided by the control logic section 403. The control logic section 403 receives inputs from the internal control panel 182 the sound reproduction means 406, the function timer section 425 and the optical sensors 15, 160 and 162. Incoming signals from the start sensor 160, the stop sensor 15 and the end sensor 162 are processed in the sensor input processing means 402, before being forwarded to the main logic control 400. The senor input processing 402 contains de-bounced op-amp stages to amplify and filter the signals from the sensors 15, 160 and 162. The sensor input processing also receives motor back emf signals from the upper and lower drive motors 12, 14 via motor control section 404. The back emf signals from the upper and lower drive motors are also

filtered and amplified and converted to a digital signal before being fed to the main logic control 400. The main logic control 400 also receives input from the internal control panel 182 which provides user selectable option signals to the main logic control 400 to change the manner in which the scrolling apparatus 10 is controlled by the control means 401. The main logic control 400 also receives input signals from the sound reproduction means 406 and the function timer section 425.

The sound reproduction means 406, in the second embodiment of the present invention, comprises a digital voice recorder and playback device 410 coupled to semiconductor memory 408. Figure 15 shows a more detailed schematic diagram of the sound reproduction means 406 in accordance with the second embodiment. Control inputs 442 are received by a logic control section 436 from the main logic control 400. The logic control 436 performs decoding logic operations on the control inputs 442 in order to select one of a plurality of memory banks 428 of the semiconductor memory 408. The logic control 436 also provides control signals to a sound control means 430. When the sound control means 430 is placed in record mode, a sound signal at an analog input 440 is amplified by an amplifier stage 434 and passed to the sound control means 430 where it is converted into a digital signal. The digitised sound signal is then stored sequentially in the memory bank 428 selected by the logic control 436 for retrieval at a later time. Then, when the sound control means is instructed to reproduce the recorded sounds, the stored data in selected memory bank 428 is retrieved sequentially via the digital data/control bus by the sound control means 430. The retrieved digital data is converted into an analog signal by a digital-to-analog converter, which signal is then amplified and filtered by op-amp stage 432, the amplification of which may be varied by potention-meter 200. The amplified and filtered analog output 438 is then fed to a speaker 414 via an on/off control relay 416.

The second embodiment utilises a single chip continuously variable slope delta-modulation (CVSD) voice recorder (such as TMS 3477 from Texas Instruments) for use as sound control means 430. Such a single chip voice recording/playback

controller interfaces directly with semiconductor memory 428 for ease of use and construction. The second embodiment utilises four one-megabit semiconductor memory chips for the memory banks 428 of storage memory 408, which allows approximately 1 minute 40 seconds of sound reproduction when the sound control 430 is set to 32 kilohertz data sampling frequency.

Sounds and control signal tones are initially recorded on magnetic tape for use with a tape player 412 (Figure 14). When the audio signal is to be stored in the digital memory the tape player 412 is coupled to the analog input 440 and a record signal is sent from the main logic control 400 to logic control 436 via the control input 442. Since the semiconductor memory banks 428 comprise volatile RAM memory a battery backup electrical supply is provided in the sound reproduction means so that audio signals stored in the memory 408 can be retained even if electrical power is switched off to the rest of the control means 401. The memory banks 428 may be sequentially pre-recorded with a single continuous audio signal, with logic control 436 automatically switching from one memory bank to the next during record and playback of the audio signal. Alternatively, the memory banks may be stored with up to four separate audio signals, one in each of the memory banks 1 to 4. This can allow up to four different audio voice messages to be pre-recorded and played back, each with its own pre-recorded control signals. A further advantage of the digital audio storage technique is that, unlike a normal magnetic tape sound reproduction device, no time is required to rewind the audio message from the end back to the beginning. The digital sound reproduction means is also much simpler in construction and more reliable than a mechanical sound reproduction means such as a magnetic audio tape player.

The control means 401 (Figure 14) is also provided with a function timer section 425. This includes a daily on/off timer 424 and a group select timer 426. The daily on/off timer 424 may be selectively programmed by the user, via the internal control panel 182 and main logic control 400, to enable the display apparatus to be automatically activated and deactivated at predetermined times during the day. For

example, the daily on/off timer may be pre-programmed to switch the apparatus on at 9 o'clock in the morning and switch the apparatus off at 5 o'clock in the evening. The daily on/off timer 424 contains a 24 hour electronic clock, memory to store switch-on and switch-off times and a comparator stage to determine the switch-on and switch-off times by comparison of the electronic clock output and the stored switch-on and switch-off times in the provided memory. When the comparator within the daily on/off timer stage 424 indicates correspondence between the electronic clock output and the stored switch-on time a switch-on signal is sent to the main logic control 400. Similarly, when the comparator determines correspondence between the pre-stored switch-off time and the electronic clock output the timer 424 is use a switch-off signal to the main logic control 400. When a switch-on signal is received by the main logic control 400 the control means 401 begins a procedure illustrated by the flow chart in Figure 18. When a switch-off signal is received the main logic control 400 enters a reset state and waits for a switch-on signal from the on/off timer 424.

The function timer section 425 also contains group select timer 426 which receives an input of the electronic clock time from the daily on/off timer 424. The group select timer 426 operates in a manner similar to the daily on/off timer 424 only, instead of indicating times for apparatus to switch on and switch off, the group select timer 426 indicates times at which the apparatus should display different groups of images.

If the image display medium 24 comprises a number of image groups 169, and the sound reproduction means 406 is pre-stored with a number of difference voice messages in the memory banks 428, then the group select timer 426 may be programmed to instruct the main logic control 400 to switch from one image group 169 and memory bank 428 to another image group and memory bank at a predetermined time. For example, if the image display medium 24 is provided with four distinct image groups 169 and the sound reproduction memory is pre-recorded with four separate voice messages, then the group select timer 426 may be pre-stored

with four 24 hour clock times at which the image display apparatus is to switch from one image group 169 and voice message stored on a memory bank 428 to the next image group and voice message.

The control means 401 also comprises a touch plate 422 which may be located on the front of the box enclosure 136, adjacent to the transparent portion for image display. The touch plate 422 is coupled to a touch switch circuit 420 such that, when a person touches the touch plate 422, the touch switch circuit 420 senses a change of capacitance in the touch plate 422 and energises a relay 416 which connects the speaker 414 to the sound reproduction means 406. When the touch switch circuit 420 senses the change in capacitance of the touch plate 422 the touch switch circuit 420 also issues a signal to the main logic control 400 which initiates a preset voice timer. When the voice timer expires the main logic control 400 issues a signal to the touch switch circuit 420 which then de-energises the speaker relay 416. Alternatively, instead of a timer, a counter may be utilised to de-energise the speaker relay 416 after a predetermined number of images have been advanced. The number of images which have been advanced may be counted using the output of the optical stop sensor 15 as an indication of the movement of images.

Figure 16 shows controls which may be available on an internal control panel 182 of the second embodiment. The internal control panel 182 includes a start push button switch 186 which activates and deactivates the image display apparatus. A run led 188 indicates whether the sound reproduction means 406 is activated or deactivated. The control panel also includes a record/play toggle switch 196 to control the sound reproduction and record means 406 to switch between record and playback modes of the digital voice recorder 410. Another toggle switch 194 enables the apparatus to be controlled by either control signals from the sound reproduction means 406 or signals from the delay timer 52 contained in the control logic section 403 of the control means 401. A thumbwheel switch is coupled to the delay timer 52 to enable the user to preset a time for which each image 23 will be displayed when the apparatus is in timer mode. Another thumbwheel switch 190 enables the user to

preset the voice counter value for the number of images during which the relay switch 416 to the speaker 414 remains closed after the touch switch circuit 420 has been activated by the touch plate 422. An input jack 198 is provided on the control panel 182 for connection of the tape player 412 to allow pre-recorded audio signals to be transferred from the tape player 412 to the digital sound reproduction means 406. An output level potentio-meter 200 of the control panel 182 allows adjustment of the level of the analog output 438 to the speaker 414. The control panel 182 is also provided with timer programming control push buttons 206, week day indicators 204 and time clock display 202. The controls 206 allow timer values to be entered for each day of the week, as indicated by the week day indicators 204, for use in the daily on/off timer 424 and the group select timer 426. A reset push button 208 is also provided which, when pressed, places the control logic into a reset state, and rewinds the images to the physical beginning of the image display medium 24.

An auxiliary control panel 184 contains three push buttons for use in loading images 23 onto the scrolling apparatus 10. A forward push button 210, when pressed, causes the motor control 404 to provide a low voltage input to the lower drive motor 14. Similarly a backward push button 212, when pressed, causes the upper drive motor 12 to be provided with a low voltage input. When the low voltage input is provided to either the upper or lower drive motor 12, 14 the upper or lower spool 16, 18 is caused to rotate slowly, thus slowly moving the image display medium 24 in one direction or the other. Using this slow movement of the image display medium the joining portion 161 between two images 23 of the image display medium 24 may be accurately positioned to allow one image 23 to be replaced by another image with the image display medium still wound upon spools 16, 18. To change one image 23 for another, the joining portion 161 would ordinarily be advanced to a position between two tractor feed devices 164 such that the two images 23 adjoining the portion 161 are held in place by the tractor feed devices 164. Whilst in this position the adhesive tape or "velcro" strips used to join the images 23 may be removed and another image placed on the tractor feed device guiding projections 172 to accurately align the new image with the adjoining image. A release push button 214 is also provided on the

auxiliary control panel 184 which acts to slowly drive the upper and lower drive motors 12 and 14 in opposite directions to reduce the tension on the image display medium 24 to enable easy replacement of images.

Figure 18 shows a flow chart 301 of the operation of control system 401 of the second embodiment of the present invention. Throughout the flow chart the following shorthand notation is utilised:

BOTSNS designates that a signal has been issued from the start sensor 160 indicating that the first image in a group of images 169 is now displayed;

EOTSNS designates that a signal has issued from the end sensor 162 indicating that the final image 171 in a group of images 169 is now displayed;

STPSNS designates that a signal has issued from the stop sensor 15 indicating that the image 23 being displayed is correctly aligned;

UPWARDS designates a direction of movement of the image display medium wherein the image display medium 24 is unwound from lower spool 18 and wound upon upper spool 16;

DOWNWARDS designates a direction of movement of the image display medium 24 wherein it is unwound from upper spool 16 and wound upon lower spool 18;

RUN designates a condition of the upper and lower drive motor inputs such that the image display medium 24 is moved in the upwards or downwards direction;

STRT VOICE designates that the sound reproduction means 406 has begun producing audio output signals; and

TONE designates a control signal from the sound reproduction means 406 which is decoded in a DTMF decoder contained in the main logic control 400.

The procedure of flow chart 301 begins at step 300 wherein the control means 401 is held in a reset state where both upper and lower motors are at rest. At step 302 the main logic control 400 issues a control signal to the motor control 404 which acts to drive the lower motor 14 until the entire image display medium 24 is wound

upon lower spool 18. As in the first embodiment, when one of the upper and lower drive motors are energised the back emf from the motor which is not energised may be used as an indication of the movement of the image display medium 24. At step 304 the UPWARDS direction is selected and during step 306 the image display medium is moved in the selected direction until the first image 167 in a group of images 169 is displayed. At step 308 the control logic 403 determines which of the four pre-stored image groups should currently be displayed and compares it with the image group which is selected (initially group one). If the image group which should be displayed does not match the selected image group step 310 acts to increment the selected image group and corresponding memory bank 428 of the sound reproduction means 406. The image display medium 24 is then advanced to the beginning of the next image group as indicated by BOTSNS and the comparison of step 308 is repeated until the image group which is selected matches the image group to be displayed. If the internal control panel 182 is set to timer mode by toggle switch 194, step 312 directs the procedure to step 314 which acts to initiate delay timer 52. When the delay timer expires step 316 directs the procedure to advance the image display medium to the next image 23 in the group of images 169 (step 318). If the upwards direction is currently selected (step 320) and the end of a image group is sensed (step 326) then the direction of movement of the image display medium 24 is reversed at step 328. Similarly, if the downwards direction is currently selected and the beginning of a image group is sensed (step 322) then the direction is reversed so that the upwards direction becomes valid (step 324). The procedure then returns to step 312 and begins again. If the voice mode has been selected via toggle switch 194 of internal control panel 182 then step 330 acts to start the sound reproduction means 406. By virtue of steps 306, 308 and 310, the memory bank 428 of the sound reproduction means 406 corresponds to the image group which is currently displayed. When a control signal (TONE) is received (step 332) it is decoded by the DTMF decoder and determined to be one of an up tone, a down tone or a rewind tone (steps 334, 336 and 338). If none of these tones are recognised then the signal is ignored (step 340) and the main logic control 400 waits for another tone to be received at step 332. If the tone is an up tone (step 334) the upwards direction is selected at step 342

and the image display medium 24 is advanced to the next image in the sequence in the upwards direction (step 318). If the tone detected is a down tone (step 336) then the downwards direction is selected at step 344 and the image display medium 24 is advanced to the next image in the sequence in the downwards direction (318). If the tone detected is a rewind tone (step 338) then the downwards direction is also selected (step 346) and step 348 acts to advance the image display medium 24 until the beginning of the selected image group 169 is sensed (step 348). Steps 320 to 328 are then carried out as in the timer mode.

Using the procedure illustrated in flow chart 301 the images 23 in a group 169 can be sequentially displayed in upwards sequence followed by downwards sequence continuously, accompanied by corresponding voice messages from the sound reproduction means 406 which issues the appropriate up and down tones. When the images of the group 169 are displayed in downwards sequence the tone issued from the pre-recorded audio signal of the sound reproduction means 406 to move from the penultimate image to the final image in the sequence (for example, the first image of the group) may be a rewind tone instead of a down tone. This restores both the image group 169 to the first image in the group and the voice message of the sound reproduction means to the beginning, thus ensuring that the voice message and the image sequence are re-synchronised in the event that an up or down tone was missed during the display of the sequence.

Figure 19 shows a flow chart 371 which is carried out by the main logic control 400 continuously during the operation of the control system 401. This procedure whether the scrolling apparatus is in a jammed condition. If either or both of the upper and lower motors 12, 14 are being driven (step 362) then a movement sensor is examined to determine whether the image display medium 24 is in fact being moved (step 364). The movement sensor may, as in the first embodiment, comprise the upper or lower motor back emf, or may alternatively comprise a shaft encoder or pulse counter. A pulse counter movement sensor may easily be incorporated in the second embodiment using an optical sensor to sense movement of the guide holes 166

along one edge of the image medium past a stationery light source. If movement is sensed at step 364 then a jam timer is reset at step 374 and step 362 is repeated. If one of the upper and lower drive motors 12, 14 are being driven and no movement is sensed from the movement sensor (step 364) then the jam timer is examined to determined whether it has been previously set (step 366). If the jam timer has not been set then step 372 acts to set the jam timer and return the procedure to step 362. If the timer has been set (step 366) and the time has expired (step 368) this indicates that one of the upper and lower drive motors 12, 14 have been energised for a predetermined time without any movement of the image display medium 24 taking place, thus indicating a jammed condition (step 370). If the jam timer has not expired (step 368) then the procedure is again returned to step 362.

Figure 20 shows a flow chart of a procedure which may be carried out by the control means 401 to change from one image group 169 to another image group. When the group select timer 426 expires (step 360) the main logic control 400 determines if the current group is the last of the preset image groups at step 352. If the current image group 169 is the last of the groups then step 354 acts to rewind the image display medium 24 to the beginning of the first of the image groups 169. Step 360 similarly acts to set the control inputs 442 to logic control 436 of the sound reproduction means 406 to select the memory bank 428 corresponding to the first image group 169. If, at step 352, the main logic control 400 determines that the current image group 169 is not the last of the preset image groups, then the upwards direction is selected at step 356 and the image display medium 24 is advanced in the upwards direction until the beginning of the next image group 169 is detected by the optical start sensor and the optical stop sensor (step 358). Step 360 is then carried out to select the next of the memory banks 428, corresponding to the new image group 169.

With reference to Figure 29, there is shown a third embodiment of the image display apparatus, indicated by reference number 600. The basic operation of the third embodiment of the image display apparatus is essentially the same as that described

in relation to the second embodiment, however including several added features. A visual display means 604 comprises a pair of parallel spaced spools each driven by a respective electric motor to enable a plurality of images joined end to end to form a length of image display medium to be coiled and uncoiled upon the spools and displayed therebetween, as described with reference to Figures 2, 9 & 10, for example. The electric motors of the visual display means 604 are controlled by a centralised control means 602. The control means 602 comprises a microprocessor or microcontroller having input and output ports for receiving data and issuing control signals to and from the various components coupled thereto, one of which is the visual display means 604, which receives signals via control circuitry 610. The microprocessor or micro controller of the control means 602 includes non volatile memory such as ROM or EPROM containing controlling instructions for the micro processor or micro controller, and RAM for storing and retrieving information relating to the operation of the image display apparatus.

The central control means 602 issues control signals to the electric motors of the visual display means 604 by way of the control circuitry 610, which comprises, for example, digital-to-analog converting circuitry and operational amplifiers, for changing digital control signals from the control means 602 into appropriate analog signals to drive or control the electric motors. Image movement and position sensors 606 derive data from the movement and position of the images in the visual display means 604, and forward such data to the central control means 602 by way of analog-to-digital and decoding circuitry 612. The apparatus 600 also includes audio storage circuitry 608, such as the digital sound circuitry illustrated and described with reference to Figure 15, which is controlled by signals from the control means 602, and which outputs sound by way of a speaker 620. The audio storage circuitry 608 also outputs sound signals to a DTMF decoder 614 which decodes the sound signals and issues data to the control means 602 in the way previously described. A control panel 616 is also included, comprising a multiple line alpha-numeric display 626, and a key pad 624. The alpha-numeric display 626 allows the control means 602 to output information to a user of the apparatus, such as menu options relating to the control of

the apparatus 600, or prompt for information from the user to be entered by way of the key pad 624.

One of the menu options selectable from the key pad 624 is the option to place the image display apparatus 600 into a remote control manual mode, which utilises an input from a remote control 618. When in the remote control manual mode a signal issued on remote line 618, by way of a wired push button switch, is received by the control means 602, which causes the visual display means 604 to advance to the next image in the sequence of images.

As in the second embodiment, the changing of the display of images in the visual display means 604 may be controlled either by way of control signals derived from the audio storage means 608, or by way of timing signals generated within the control means 602. When the latter method is adopted in the third embodiment, the display time for each of the individual images may be programmed individually, and flowchart 650 for this procedure is illustrated in Figure 30. The programming begins at step 652 and at step 654 the image display medium is rewound to its beginning. The first image of the first group of images is then displayed at step 656. Whilst the first image is being displayed the control means 602 utilises the alpha numeric display 626 to prompt a user to input a display time delay for the image currently displayed (step 658), in response to which the user inputs a time delay in seconds by way of the key pad 624. The delay time inputted at step 658 is stored by the control means 602 (step 660) in RAM memory, in a location thereof which is associated by the control means 602 with the image currently on display. At step 662 the control means determines whether the currently displayed image is the last image in the entire sequence of images contained in the visual display means 604, and if the last image is detected the procedure is terminated at step 664. If the last image is not detected at step 662 the next image in the sequence of images is displayed by the visual display means 604 (step 666). The control means 602 again prompts the user to input a display time delay for the image displayed (step 668) and the delay time programmed by the user is stored in memory at step 670. Thereafter the procedure

returns to step 662 and repeats steps 662 to 670 until each of the images in the sequence has been allocated a display time delay. Once having been programmed in this manner, the control means 602 is then able to control the visual means 604 such that each image in the sequence is displayed for an amount of time corresponding to that stored in the memory location corresponding to that image.

One way in which the above procedure may be more easily facilitated is by providing each image in the visual display means 604 with a label containing a unique barcode. Such a barcode label may be provided on each image 23 (see Figure 2) in place of a stop tab 13, positioned in a corner of the image 23. A barcode reader may then be provided in a manner similar to optical sensor 15 (Figure 7), comprising a portion of the image movement and position sensors 606. Barcode decoding circuitry (612) may then be provided to receive signals from the barcode sensor to output the unique code to the control means 602. In this way, the unique code derived from the barcode label may be used by the control means 602 as an index to the memory location at which to store the delay time for the corresponding image, during the programming procedure 650. The code may again be used during normal operation to retrieve the delay time from the RAM memory.

The image display apparatus 600 is further provided with a vicinity movement sensor 622, which may be an ultrasonic or infared type detector of the type used in burglar alarm detection systems. This feature allows the image display apparatus 600 to actively operate only when movement of people is detected in the immediate vicinity of the apparatus. By disabling movement of the images and de-energising the lights of the visual display means 604 whilst no movement is detected in the vicinity of the apparatus 600, reduced power consumption and reduced wear and tear of both the apparatus and the image display medium can be achieved. A procedural flow chart of operation of the control means 602 utilising an input from the vicinity movement sensor 622 is illustrated at 675 in Figure 31. At step 680 a movement timer is started, being initially zero. As in all the timed functions in the third embodiment, the movement timer may comprise an internal timer of the micro